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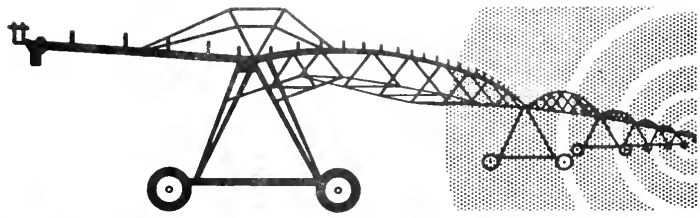

Illinois Irrigation Newsletter

This newsletter supported in part by the Water Resources Center of the University of Illinois at Urbana-Champaign

Vol. 11, No. 1 *March, 1989*

IN THIS ISSUE:

Choosing Corn and Soybean Varieties for Irrigation

Selecting an appropriate corn hybrid or soybean variety is an important first step in realizing the economic return from your irrigation system. The environment under your irrigation system is different from what dryland farmers experience, and you need to consider this when choosing a seed source. Irrigation reduces moisture stress (providing better growing conditions) and increases humidity. The improvement in quality of the growing season and the potential for increased moisture-related disease will influence your variety-selection decisions. It's important to evaluate corn and soybean varieties for irrigation by examining performance *under irrigation*. The University of Illinois tests commercial varieties under irrigation at the Illinois River Valley Sand Field, which is located 10 miles west of Kilbourne in Mason County. The soil at the test field is a Plainfield sand, a coarse-textured sand of low water-holding capability. Finer-textured sands may provide greater corn and soybean yields than those measured at Kilbourne.

What characteristics should a corn hybrid have to be suitable for use under irrigation? The hybrid should be able to perform at populations high enough to take advantage of the improved growing environment (28,000 plants per acre is a good target for sand). It should resist lodging, because irrigated corn may have shallower roots and is more likely to be subjected to a combination of wet soils and wind. The hybrid should have good husk-cover and turndown characteristics that will prevent the ear from spoiling due to moisture exposure. The corn should be able to resist foliar diseases that are promoted by high humidity conditions, and it should have good dry-down characteristics.

Interpreting Yield Trials

How would you respond to a cashier's handing you five dollars when you were owed eight dollars? Would it make you feel better or worse if he or she explained that there was "no statistical difference between five and eight dollars"? (I doubt it would make John Rote feel any better.) Usually we deal with mathematics that have no statistical variation, where 2 + 2 = 4, 4 is less than 5, and so forth.

When we consider experiments, we introduce natural variation that can never be controlled. We will never know precisely, for instance, the yield of any corn hybrid at the Sand Field. We can only estimate yield by doing replicated or repeated tests. One "strip" of corn may give us some idea (better than none at all); but two strips would be better, because we would spread our chances of planting the corn on an "unusual" spot in the field. Three strips are better than two, and so on. By using statistics, we attempt to quantify this variability and get some idea of

Table 1. Corn and Soybean Cultural Practices at Kilbourne

Crop	Planting date	Irrigation	Fertilizer through system
corn	May 12	1 inch every 4 days	100 pounds nitrogen
soybeans	May 12	18.7 inches	27 pounds potassium

our estimate's accuracy. Table 1 gives general background on the corn and soybean cultural practices at Kilbourne.

Using statistics, we can make statements such as, "We are 70 percent sure that hybrid A yields more than hybrid B when grown at Kilbourne under irrigation." If we have big differences between A and B, then our "70 percent sure" estimate becomes easier. But if we measured the yield of hybrid A as 185 bushels per acre and hybrid B as 183 bushels per acre, we would be less likely to make a conclusive statement than if the yields were 185 and 135 bushels per acre, respectively. Statistics help us interpret data and prevent us from making incorrect decisions based on too few experiments or too few observations.

How important is it to choose the right corn or soybean variety? If the seed is available at the same price, the penalty for making a decision based on nonsignificant yield differences is quite small. Consider the following example: hybrid A is said to yield 185 bushels per acre, and hybrid B is said to yield 170 bushels per acre. The experimenter says that differences less than 22 bushels per acre are statistically insignificant at the 10 percent level. This means one cannot be 90 percent sure that A yields more than B. One could, however, be about 70 percent sure that A yields more than B. What degree of confidence should an irrigator accept when choosing varieties? Again assuming equal cost of seed, 70 percent confident would be an acceptable level, because there is only a 30 percent chance that hybrid B actually yields more than hybrid A.

Tables 2 through 5 list data by brand of corn and soybean for different maturity groups at Kilbourne. The Least Significant Difference (LSD) values found at the end of the corn and soybean variety listings can be used to compare varieties. The 30 percent level refers to "70 percent sure." For corn hybrids in 1988, the value for yield next to the 30 percent level is 14 bushels. That is the comparison value to use for 1988 corn-grain yield accepting the "70 percent sure" level of confidence.

For a complete listing of dryland and irrigated commercial variety trials, obtain copies of Circular 1288, *Performance of Commercial Corn Hybrids in Illinois*, and Circular 1289, *Performance of Commercial Soybeans in Illinois*, from your county Cooperative Extension Service agricultural adviser.

Table 2. Corn Results at Kilbourne

	1988		1987		1986	
Brand hybrid	Yield bu/A	Moisture percent	Yield bu/A	Moisture percent	Yield bu/A	Moisture percent
Agratech						
GK 750	196	22.2	132	20.7	161	22.3
WS 2510	173	22.7				
Agripro						
AP 510	203	22.4	160	19.6		
AP 595	186	22.1				
AP 670	202	21.8	165	21.5	171	22.9

Table 2. Continued

Brand hybrid	1988 Yield bu/A	1988 Moisture percent	1987 Yield bu/A	1987 Moisture percent	1986 Yield bu/A	1986 Moisture percent
Ainsworth						
X-516A	187	22.7				
X-617	186	23.9	160	21.0	158	24.2
X-717	182	24.3				
Asgrow/O's Gold						
2545	198	21.9	178	19.7	180	23.6
RX759	187	20.6				
RX788	185	22.0	139	20.1	149	22.4
Bo-Jac						
602	185	22.7				
6760	200	25.3				
Burrus						
BX26	164	22.6	160	19.7	170	23.4
BX68	188	21.6				
BX88	191	23.2				
Cargill						
76046	186	22.6				
7877	200	21.1	176	17.6		
7993	180	23.0	164	19.5		
8027	191	22.2				
Coker						
8590	169	22.7				
8601	188	22.0	133	18.4	163	21.4
8625	194	21.7			146	22.3
8628	177	22.7				
8677	204	23.5				
8690	192	23.3				
CX 7681	166	18.1				
Crow's						
446	177	20.5				
482	196	20.8	142	18.0		
488	184	19.6	132	17.9	166	21.9
647	158	23.2				
682	214	24.3				
692	173	24.8				
DeKalb-Pfizer						
DK-636	194	22.2	183	19.4	164	22.3
DK-656	183	23.1	152	20.1	143	23.7
Garst						
8344	196	22.5				
8388	201	22.0				
8393	178	23.4				
8519	190	21.8				
8532	180	21.6				
8536	192	21.2				

Table 2. Continued

Brand hybrid	1988 Yield bu/A	1988 Moisture percent	1987 Yield bu/A	1987 Moisture percent	1986 Yield bu/A	1986 Moisture percent
Golden Harvest						
EX 480	175	21.0				
H-2572	183	22.8	164	19.4	165	23.2
H-2583	197	22.2				
H-2602	203	20.4	176	17.8	178	21.8
H-2607	187	21.9				
H-2629	183	22.7				
Growmark						
FS 6774	170	22.0				
FS 6933	174	22.3	132	19.5	165	22.4
FS 6992	201	21.3				
King						
K448	165	17.9				
K5574	155	16.3	127	16.9	164	20.2
K598	188	21.9				
K647	195	22.8	167	20.1	154	22.5
Lewis						
4685	182	21.9				
5595	175	20.7	163	18.3	163	20.8
5910	205	22.5	156	20.3	164	22.4
6756	190	24.2	138	21.3		
Noble-Bear						
NB2562	198	23.4				
NB848	182	22.5				
NBX629	187	22.3				
Northrup King						
N 6873	191	21.5				
S 7686	187	21.7				
Payco						
SX 1087	204	24.4				
SX 800	173	20.0				
SX 900	204	23.6	167	19.7	151	22.9
SX 925	182	23.1	147	19.0	186	22.8
Pioneer						
3181	186	22.9				
3295	212	22.9				
3312E	196	20.5				
3343	168	23.0				
3377	192	21.5				
3379	206	22.0				
Shissler						
GR-8 189	190	22.1	169	20.2		
Super-Crost						
5415	184	23.1	141	19.6		
EXP 8116	135	20.5				
Terra						
TR 1110	173	22.2				
TR 1120	187	22.5	121	19.5	163	22.8
TR 1125	203	21.2	126	18.6		

Table 2. Continued

Brand hybrid	1988 Yield bu/A	1988 Moisture percent	1987 Yield bu/A	1987 Moisture percent	1986 Yield bu/A	1986 Moisture percent
Thor-O-Bred						
SSX 532	186	21.2				
SX 544	189	21.5				
Voris						
V 2495	180	19.8				
V 2565	181	21.8				
Average	185	21.4	147	18.9	156	22.4
LSD 10 percent level	22	1.0	26	1.6	230.9	
LSD 30 percent level	14	0.6	16	1.0	150.5	
Standard error of cultivar mean	10	0.4	11	0.7	10	0.4

Table 3. Maturity Group II: Soybean Results at Kilbourne

Brand cultivar/blend	1986-1988 Yield bu/A	1987-1988 Yield bu/A	1988 Yield bu/A	1988 Maturity date	1988 Lodging	1988 Shattering
Agraectus						
108			43.2	9/07	2.0	1.3
McCubbin Seed Farm, Inc.						
Taylor	47.2	33.6	43.0	9/20	1.2	1.0
Pioneer Hi-Bred International						
9271			44.7	9/10	1.0	1.0
9272			35.1	9/22	1.0	1.0
9293			41.5	9/20	1.2	1.0
Public Variety						
BSR 201	36.0	24.4	32.9	9/22	1.0	1.0
Burlison			46.2	9/22	1.0	1.0
Century 84	37.2	25.8	34.9	9/17	1.0	1.0
Conrad			50.9	9/10	1.3	1.3
Corsoy 79	36.4	25.4	32.4	9/07	1.3	1.3
Elgin 87	42.8	29.6	42.6	9/12	1.2	1.0
Gnome 85	37.1	25.7	40.3	9/17	1.0	1.0
Hack	38.4	25.4	36.5	9/17	1.0	1.0
Preston	41.7	29.2	41.4	9/14	1.2	1.0
Average	39.6	27.4	40.2	...	1.2	1.1
LSD 10 percent level	...	...	12.6	...	0.3	0.3
LSD 30 percent level	...	...	7.8	...	0.2	0.2
Standard error of cultivar mean	3.9	3.1	5.2	...	0.1	0.1

Table 4. Maturity Group III: Soybean Results at Kilbourne

Brand cultivar/blend	1986-1988 Yield bu/A	1987-1988 Yield bu/A	1988 Yield bu/A	1988 Maturity date	1988 Lodging	1988 Shattering
Agracetus						
305			42.8	9/30	1.0	1.0
Lewis Hybrids, Inc.						
367		39.6	55.4	9/28	1.5	1.0
McCubbin Seed Farm, Inc.						
Gentry			48.5	9/28	1.2	1.0
Merschman Seeds						
Washington VI			50.3	9/30	1.0	1.0
Northrup King Company						
S39-99			44.6	9/30	1.2	1.7
X8832			50.2	9/22	1.0	2.0
Pioneer Hi-Bred International						
9301			47.6	9/22	1.5	1.3
9361			51.5	9/30	1.3	1.0
9391			42.8	9/30	1.2	1.0
Public Variety						
Cartter	43.9	34.9	49.4	9/20	1.0	2.0
Chamberlain	46.2	36.9	43.1	9/24	1.0	2.0
Harper 87	44.0	33.8	44.9	10/03	1.0	1.0
Hobbit 87		32.7	49.4	9/28	1.0	1.0
Pella 86	42.3	30.2	45.3	9/22	1.0	1.7
Resnik		32.2	38.4	9/22	1.0	1.0
Sherman	45.7	36.8	47.2	9/30	1.0	1.0
Average	44.4	34.6	47.0	...	1.1	1.3
LSD 10 percent level	...	...	8.4	...	0.2	0.3
LSD 30 percent level	...	...	5.3	...	0.1	0.2
Standard error of cultivar mean	1.6	3.0	3.5	...	0.1	0.1

Table 5. Maturity Group IV: Soybean Results at Kilbourne

Brand cultivar/blend	1986-1988 Yield bu/A	1987-1988 Yield bu/A	1988 Yield bu/A	1988 Maturity date	1988 Lodging	1988 Shattering
McCubbin Seed Farm, Inc.						
EX 48864			44.7	10/03	1.3	1.0
Public Variety						
Pixie	35.2	22.7	36.1	9/30	1.0	1.0
Ripley	40.5	27.8	39.2	10/03	1.0	1.0
Union	39.3	26.7	32.6	10/03	1.5	1.0
Average	38.3	25.7	38.1	...	1.2	1.0
LSD 10 percent level	...	...	8.4	...	8.2	...
LSD 30 percent level	...	...	4.9	...	0.1	...
Standard error of cultivar mean	2.8	2.7	3.0	...	0.1	...

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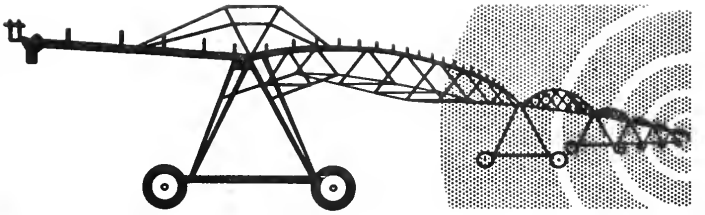

Illinois Irrigation Newsletter

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Vol. 11, No. 2 *June 1989*

IN THIS ISSUE:

Legislation Governing Groundwater Quantity

Legislation affecting irrigators has been introduced in both the Senate and House sections of the Illinois State Legislature. The ultimate fate of these bills is somewhat unpredictable, as the political process evaluates, amends, and passes judgment on them. Some bills appear destined to stall in committee, while others may serve as vehicles for further amendments.

Some form of groundwater-quantity legislation seems likely to pass in this or future legislative sessions. Why is there interest in groundwater-quantity legislation? There is considerable focus on water-use conflicts in the Kankakee County and Iroquois County area. Last summer more than 160 complaints from owners of potentially affected domestic wells were filed with the Soil and Water Conservation District offices. Most of these complaints were rejected because the wells were inadequate or substandard. Nonetheless, attention remains focused (fairly or unfairly) on the irrigators.

Residents in other areas have felt impaired by the loss of artesian pressure near recently drilled irrigation wells. A scorching drought serves to heighten water-use tensions, and this was the case last summer. Many people feel about water the way animals feel about a shrinking oasis, and it's natural that conflicts will arise.

A third motivating factor for groundwater-quantity legislation is the interest of some rural areas to protect themselves against the "aquifer encroachment" of surrounding municipalities. In some cases irrigators see their livelihood or future economic development threatened by municipal or commercial use of water. Some irrigators have postulated that a groundwater-management plan might reduce the chance of large municipal wellfields being located adjacent to their farms.

The 1980s have seen significant legislative activity dealing with water issues. The Water Use Act of 1983 established a general framework of water law onto which additional amendments could be added. In 1987, the Illinois Groundwater Protection Act was put into place. With it came setback regulations to protect municipal wellheads. With a start in water-quality legislation, attention swung back to water-quantity issues, spurred in part by regional conflicts over water use and fueled significantly by the drought in 1988.

Since February 1988, the Groundwater Committee of the State Water Plan Task Force has been studying the various legal, hydrogeologic, and management issues that must be considered in order to manage groundwater quantity effectively. The bill is a vehicle for legislation

being drafted by the governor's office, the Division of Water Resources/DOT, the Department of Agriculture, the Department of Public Health, the Illinois EPA, the Department of Energy and Natural Resources, the Department of Mines and Minerals, and the Water Resources Center at the University of Illinois. In February, two public meetings were held on the proposed legislation.

House Bill 2710

House Bill 2710 was the primary legislative vehicle to carry forth the recommendations of the Governor's Task Force. It was introduced by Rep. Weller. The bill is cited as an Act in relation to the development and management of the groundwater resources of the State of Illinois. The bill states that if an investigation by the Department of Transportation discloses that an existing high-capacity well is causing the delivery system of a domestic well to fail or is causing a significant reduction the Department may require the high-capacity well owner to pay for all or part of the cost of (a) replacing the affected water-supply system or (b) undertaking remedial measures necessitated by the well's interference. Compensation may be required only after the parties demonstrate to the Department that an effort to negotiate reasonable compensation has been made and has failed.

The Department may require itemized estimates for repair or replacement of the domestic system and would consider the age and condition of the affected system in determining compensation. The high-capacity well owner (irrigator) would not be required to pay compensation before having an opportunity to perform test-pumping authorized by the Department.

It would be the responsibility of the owner of the domestic well to have the affected well inspected by a licensed water-well contractor and to furnish the resulting report to the Department. To qualify the owner for compensation, the domestic well must have existed and been in active use before construction of the large-capacity well or before a significant change in use of the high-capacity well caused interference problems. Wells developed after January 1, 1991, must be constructed according to the Department's specifications to be eligible for future well-interference compensation.

Funding upgrades of domestic wells. One of the most controversial portions of the bill contains plans for a fund to be used to upgrade or repair domestic wells affected by high-capacity wells. The money would be raised by assessing owners of high-capacity wells a fee based on their highest estimated water use. The fund would be established in counties with a demonstrated history of interference problems. It would not be used to bring domestic wells up to "Illinois Water Well Construction Code" standards but rather to upgrade qualified wells suffering interference. County boards would be responsible for reviewing the fund and making proportional refunds to high-capacity well users if there were no additional interference problems.

Plans for groundwater-quantity management. A key feature of the bill is the machinery to create a plan for groundwater-quantity management for counties that desire such action. A County Board may request that the Department conduct an initial assessment of future groundwater needs and of the probability of future conflicts. Based on the assessment, a County Board may request a "groundwater quantity management plan." Such a plan (prepared at the state's expense) might include recommendations for the spacing of wells, standards of well construction, requirements for water use conservation and efficiency, reporting of water use, and provisions concerning the timing of withdrawals and the range of pumping levels and maximum rates. If a county decides to come under a management plan, all large-capacity (>100,000 gpd) well owners must file an annual report of how much groundwater they withdraw.

Farm Bureau Concerns

The Illinois Farm Bureau has issued a position paper on water law that supports the provisions described below. The provisions reflect the views of the Illinois Farm Bureau, which are not necessarily those of any other organization or persons.

- Amend the Water Use Act of 1983 rather than create confusion with a new Act.

- Plan locally with the involvement of the Soil and Water Conservation Districts. The Farm Bureau believes that the SWCDs are logical choices to provide local input.
- Designate the Illinois Department of Agriculture as the lead state agency in groundwater-quantity management. As currently proposed, the Illinois Department of Transportation will be the lead state agency (HB 2710). The Farm Bureau is in apparent opposition to having that agency in leadership.
- Use the Illinois Department of Agriculture's well-construction standards as a prerequisite to holding anyone financially liable for upgrading another's well.
- Establish liability limits on the amount that large-capacity well owners must pay for upgrading domestic wells. Current proposals do not suggest a limit or maximum amount that an irrigator might be required to pay.
- Impose penalties for drilling illegal wells. The Farm Bureau suggests that it should be illegal for a driller to install a well that does not meet the Illinois Department of Agriculture's well standards.

Other Legislation

Two bills introduced by Sen. Joyce (SB 249 and 250) are amendments to the Water Well Construction Code. SB 249 ensures that owners of affected domestic wells have a potable water supply. SB 250 requires permits for construction of all water wells (currently required of potable water wells only).

House Bill 884, introduced by Rep. Johnson, would amend the Water Use Act to require public hearings and permits for proposed high-capacity wells and would extend the emergency restrictions on groundwater use to all Illinois counties (currently only Kankakee, Iroquois, McLean, and Tazewell counties have emergency restriction provisions) not covered by the Level of Lake Michigan Act. Under HB 0884, a permit would not be granted to drill a well if (a) use of the well is likely to have a significant effect on surrounding water withdrawal or (b) the proposed design does not meet standards for construction, pumps, and so forth. If adopted, this bill would remove the decision of whether to begin installing an irrigation well from the hands of the irrigator.

Rep. Satterthwaite introduced a bill (HB 1196) to amend the Civil Administrative Code of Illinois to have the Division of Water Resources establish a committee that will develop a permit system for water use. As listed in the bill, the committee shall include representatives from at least the Department of Conservation, the Illinois EPA, the State Geological Survey, the State Water Survey, the State Natural History Survey, "the field of civil engineering" (?), and users of industrial, agricultural, and municipal water. How each of the required representatives will function is not clear. Updates on legislative action will appear in the next several issues of *Illinois Irrigation Newsletter*.

Table 1. Bills Under Consideration in the Illinois State Legislature

Bill	Action	Sponsor
SB 249	Amends Water Well Construction Code	J.J. Joyce
SB 250	Amends Water Well Construction Code	J.J. Joyce
HB 884	Amends Water Use Act of 1983	Tim Johnson
HB 1196	Water Use Permit Plan	H. Satterthwaite
HB 2710	Creates Illinois Water Quantity Management Act	J. Weller

Tidbits

The Illinois Irrigation Association conducted a business meeting at the January 18 meeting of the Illinois Fruit and Vegetable Growers Foundation, held in Springfield. IIA board members elected to two-year terms are Carlisle Dame, Jerry Hoekstra, Tom Meade, and Keith Whitlow. Completing their terms of service were Rick Alton, Larry Powers, Steve Rosengren, and Lloyd Stone. Many thanks to those completing their terms, and welcome to the new board members. A full roster of IIA's board members will appear in the next issue of *Illinois Irrigation Newsletter.*

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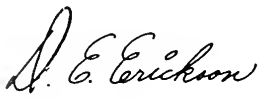

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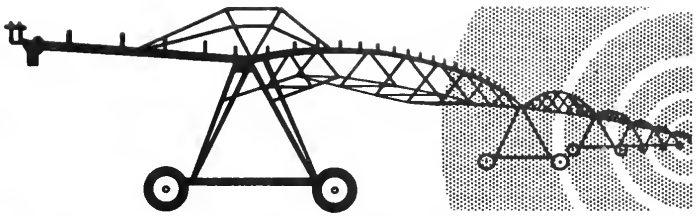

Illinois Irrigation Newsletter

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Vol. 11, No. 3 *August 1989*

IN THIS ISSUE:

Critical Period for Water and Nitrogen Is Here

Field corn planted in a timely manner is in the most important period of its growth cycle: silk emergence and pollen shed. This period typically occurs 9 to 10 weeks after emergence. The leaves and tassels are completely emerged, and stem elongation is complete. The ear shank and husks will soon cease growing. The cob and silks are growing rapidly, and the tiny ovules that hopefully will develop into grains of corn are enlarging. Individual silks attached to an ovule will continue to lengthen until they are fertilized by shedding pollen.

Timely irrigation is critical during this period. The number of ovules that will ultimately develop is being determined at this time. Moisture stress at this juncture will limit the eventual yield. The blister stage follows pollination and marks the beginning of kernel weight increase. Like the other stages that follow, the blister stage lasts about 12 days. In 60 days, the corn grain will be physiologically mature, that is, fully grown. The blister stage is named for the resemblance the developing kernels have to water blisters. The cob husks and shank are fully developed at this time, and the plant continues rapid uptake of nitrogen and phosphorus. In addition to plant uptake from the soil, nitrogen and phosphorus begin to move from the leaves and stalk into the developing grain. If nutrition is inadequate in the corn plant, the loss of nitrogen and phosphorus from the leaves may cause their premature death.

The three-week period that starts as the tassels elongate is the most critical for determining final corn yield. Favorable soil moisture and adequate nutrition will establish maximum yield potential. Irrigators who fall behind with water or nitrogen during this period will see the results (or lack of results) at harvest. For maximum effectiveness, most of the nitrogen should be applied before tasseling.

Chemigation Benefits

Chemigation is a general term encompassing application of fertilizers (primarily nitrogen), herbicides, insecticides, or fungicides through an irrigation system. As many as 80 percent of Illinois center-pivot irrigators who grow corn put nitrogen through their irrigation systems. Herbicide and insecticide use in chemigation is less widespread but not uncommon.

Fertigation, particularly application of nitrogen through an irrigation system, may provide an environmental benefit by allowing irrigators to supply this mobile nutrient when the crop needs it most. This practice may be superior to soil applications for protecting groundwater quality. Nitrogen that is spoon-fed to corn is less susceptible to leaching losses. Fertigation of corn may be a valuable best-management practice, particularly on sandy soils.

Current Chemigation Laws in Illinois

Legislative activity directed at irrigators can change the way they farm, pump water, or apply agrichemicals. In recent years, Illinois

irrigators have seen water use legislation introduced in selected areas of the state. Legal interpretations of water use have been changed dramatically. There appears to be some interest in chemigation and its relation to water quality. As with any potential legislative issue, it's important for irrigators to keep informed and offer input to foster a reasonable outcome.

A recent meeting sponsored by the Champaign County Soil and Water Conservation District drew attention to the current status of chemigation legislation (or the lack thereof) in Illinois. Representatives from the Cooperative Extension Service, the University of Illinois, the Illinois Department of Agriculture, and the Illinois Environmental Protection Agency were present to discuss chemigation with local irrigators and members of the Illinois Irrigation Association. Questions such as Does chemigation pose a water quality threat in Illinois? and Would legislation help protect our valuable resource? were posed to the group. There was a variety of responses but no consensus.

Increased scrutiny of irrigators, and of the effects of their practices on the environment, has become more pronounced in recent years. The use of irrigation with sandy soils has focused attention on water quality aspects of crop production. Does Illinois have a problem with "chemigation caused" groundwater contamination? What likely changes in regulations can we look for in the future? Illinois does remain "less regulated" than several neighboring states. A review of chemigation practices and legislation in neighboring states will be useful.

Chemigation Regulations in Nearby States

Three nearby states offer a range of regulations--from Wisconsin's slight, to Nebraska's comprehensive training, testing, and issuing of permits. Kansas offers a set of regulations that is intermediate: less training and testing than Nebraska, but more inspection and report filing than Wisconsin. Table 1 gives a general comparison among the three states. Wisconsin's approach is simply to issue a permit to chemigators much the way that permits for irrigation wells are issued in Illinois. Kansas provides for inspection and annual permit renewal. Nebraska has a comprehensive program that requires training, certification, and inspection. Illinois is theoretically unregulated at the state level; but it is subject to adherence to recently improved pesticide labels that describe in detail conditions under which products can be used for chemigation.

In Nebraska, a permit is obtained from the local Natural Resources District and is granted after the application is reviewed and the irrigation system is inspected. Permit holders must notify the district when changes or alterations to the irrigation system are made, at which time an inspection is scheduled. The district is empowered to deny or revoke a permit when it concludes there is a danger to persons or the environment if the chemigation system is used.

Chemigator training is conducted in Nebraska by the Cooperative Extension Service much the way that pesticide applicator training is done in Illinois. A certificate is awarded following satisfactory completion of a written exam. In Nebraska, both the chemigation system and the chemigator are held up to inspection.

Pesticides Labeled for Chemigation

Labels on pesticide products intended for use through irrigation systems must include directions and restrictions on use. Table 2 lists products labeled for use in chemigation sys-

Table 1. Chemigation Regulations in Kansas, Nebraska, and Wisconsin

	Kansas	Nebraska	Wisconsin
Applicator training required	No	Yes	No
Applicator testing required	No	Yes*	No
Certification required	No	Every 2 yrs	No
Permit required	Yes	Yes	Yes
Annual renewal of permit	$50	$10	No
Inspection required	**	Yes	**
Spot inspection	Yes	Yes	No
Reports required	Yes	No	No

*Fifteen dollar testing fee

**Information not available

Table 2. Pesticide Products Labeled for Use in Chemigation Systems

Herbicides	Insecticides	Fungicides
Aatrex Nine-O, 4L, 80W	Ambush and Ambush 25W	Benlate
Atrazine 4L, 5L, 80W	Baythroid 2	Benlate 500F
Bicep, Bicep 6L	Capture 2EC	Manex
Buctril ME4	Dimethoate 400	Manex II
Dual, Dual 8E	Dipel ES	Manzate 200
Eptam 7E	Di-Syston 8	Dithane F-45
Eradicane Ext, 6.7E	Guthion 2L, 2S, 35%WP	Kocide 101, 404S
Lariat	Larvin 3.2	
Lasso	Lorsban 4E, 4E-HF	
Lasso Atrazine	Pounce 3.2EC, 25WP	
Lasso EC, MT	Pydrin 2.4	
Prowl	Sevin SL, XLR Plus, 4F, 50W, 80S	
Saddle		
Sencor DF, 4		
Sonalan EC		
Surflan AS, DF		
Sutan + 6.7E		
Sutazine +		
Tandem		
Treflan EC		
Vernam 7-E		
606		

Always READ THE LABEL before use of a product.

tems. Products whose chemical and physical properties would allow their use through irrigation systems, but are not labeled for such use, must contain the following statement: "Do not apply this product through any type of irrigation system."

Label Statements for Sprinkler Chemigation in Illinois

Pesticide manufacturers are required to state specifically on the label if they do not want their product used for chemigation. Labels for agrichemicals intended for use through sprinkler irrigation systems must include specific requirements for legal use. The following system components and design must be in place to legally put pesticides through an irrigation system in Illinois.

1. A functional check valve, vacuum relief valve, and low pressure drain located on the irrigation pipeline to prevent backflow.
2. An automatic, quick-closing check valve on the pesticide injection pipeline to prevent fluid flowing back toward the injection pump.
3. A normally closed, solenoid-operated valve located on the intake side of the injection pump and connected to the system interlock to prevent supply tank withdrawals when the irrigation system is shut down.
4. Interlocking controls to automatically shut off the pesticide pump when the water pump motor stops.
5. A pressure switch in the irrigation line that will stop the water pump motor when pressure drops to the point where pesticide distribution is adversely affected.
6. A metering pump such as a positive displacement injection pump (for example, a diaphragm pump) that is capable of being fitted with a system interlock.

Drip or trickle systems must include all of the above components. Chemigation systems connected to public water supply systems (rare occurrences) require all of the above and a complete air gap between the overflow rim of the reservoir tank and the fill pipe. The reservoir tank is required since direct connection to the water supply is illegal. A public water supply is defined as a system with 15 connections or serving 25 individuals. Additional

information should appear on product labels used for chemigation. These subjects include:

1. Agitation recommendations.
2. Recommendations for timing of pesticide injection with respect to the irrigation cycle.
3. Mixing instructions for pesticide dilution in the spray tank.

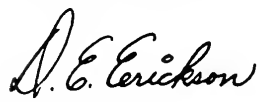
Tidbits

Tom Meade was the host for a summer Irrigation Tour held recently in Lee County. Jim Morrison, Lee County Extension Adviser, did his usual fine job in cooperation with Illinois Irrigation Association board members Dave Didier, Tom Meade, and Marty Montavon. As usual, the University of Illinois contingent brought rain to the drought-stricken area.

The Illinois Irrigation Association belatedly welcomes Dean Sisson to its membership. A Kilbourne native, Dean is being groomed for a future leadership role in the association.

Keith Whitlow, our board member from the Southern region, is not to be confused with the recently deceased Keith Whitley of country music fame.

C.J.W. Drablos
Extension Agricultural Engineer



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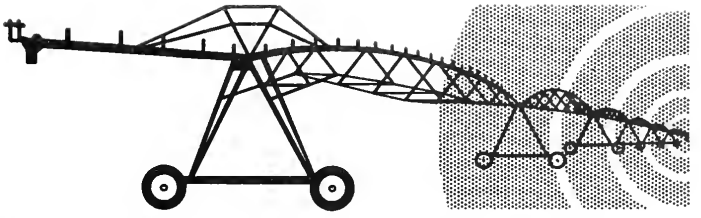

Illinois Irrigation Newsletter

This newsletter supported in part by the Water Resources Center of the University of Illinois at Urbana-Champaign

Vol. 11, No. 4 *December 1989*

IN THIS ISSUE:

Economics of Irrigation Costs--1989 Update

Irrigation can be a profitable undertaking if the benefits of increased production from irrigation offset the costs. A 160-acre center pivot system covers about 134 acres without a corner system. An array of yields necessary to cover irrigation costs is a useful step in evaluating whether to invest in irrigation. After establishing this base, producers should investigate whether they have the potential to exceed these yield levels.

As shown in Table 1, a total investment of $53,271 would equal an investment of $397.54 per acre ($53,271 per 134 acres). Your investment may go up another $5,000 to $10,000 depending on certain options in the system.

Table 1. Initial Investment

	Cost	Cost per acre
Center pivot	$31,272	$233.36
Well (80 to 100 ft)	7,000	52.24
Pump	10,000	74.63
Engine generator (diesel)	4,000	29.85
Miscellaneous	1,000	7.46
Total (for 134 acres)	$53,272	$397.54

These options may include injection pumps and different methods of powering the system, such as electric motors or hydraulics. Other factors that affect the price of a system are the size of the pipes of nozzles used, whether the system operates under high or low pressure, and whether it can be moved from one point to another. (Initial investment costs for the system given in Table 1 varied from $53,272 to $64,700 according to dealers contacted. Illustration of annual fixed and variable costs are included in Table 8.)

In addition to covering the fixed cost of the system (given in Table 2), the operating costs would also have to be recovered for 8 inches of water applied per acre. Diesel fuel requirements for 700 hours of operation with 5 gallons of fuel consumed per hour would equal 3,500 gallons of fuel per year. Assuming a price of $0.95 per gallon, the fuel costs would equal $3,325. Additional costs for oil and oil filters would total $200, making the total operating cost approximately $3,525 (see Table 3). The operating cost will vary from year to year, depending on the hours of operation and the price of fuel.

Table 2. Annual Fixed Costs

Annual average fixed costs	Average cost per unit	Average fixed costs per acre
Depreciation (10 yrs = 10%)	$5,327	$39.75
Interest (11% per year[a])	2,929	21.86
Repairs[b]	1,598	11.93
Total fixed costs	$9,854	$73.54

[a]Assumes equal payments over 10 years; the average annual rate would equal 5.5 percent of the fixed investment.
[b]Assumes 3 percent of the investment would be paid for repairs on the average.

Table 3. Fixed and Variable Operating Costs

	Cost	Cost per acre
Annual average variable costs		
Diesel fuel (3,500 gal @ $0.95/gal)	$3,325	$24.81
Oil and oil filters	200	1.49
Total annual average variable costs	$3,525	$26.30
Total fixed and variable costs	$13,379	$99.84

Table 4. Break-Even Yield Increase Needed to Cover Fixed and Variable Irrigation Costs

Corn price per bushel	Yield increase in bushels	Soybean price per bushel	Yield increase in bushels
$1.50	67	$4.75	21
1.70	59	5.00	20
1.90	53	5.25	19
2.10	48	5.50	18
2.30	43	5.75	17
2.50	40	6.00	17
2.70	37	6.25	16
2.90	34	6.50	15

Based on total annual fixed and variable costs of $13,379, the irrigation cost per acre (134 acres total) would be $99.84. The long-run added returns needed to break even under this cost structure are given in Table 4.

Additional operating costs that exceed the fixed and operating costs of the system should also be considered. These costs arise from changes in the method of farming and increases in the number of bushels produced. The costs may or may not apply to everyone, but they should be considered in any analysis. Assuming that the acreage irrigated would be rotated between corn and soybeans, such additional costs are given in Table 5.

If all these additional costs ($3,744) are added to the fixed and operating costs for the system ($13,379), then total additional costs assumed by the irrigator would come to $17,123, or $127.78 per acre.

Table 6 gives returns needed to recover the total costs of operating the system.

Any yields or prices exceeding the ones shown would involve a return to land, labor, capital, and management, depending on how they are valued in the total farm analysis. Finally, in determining whether or not irrigation equipment should be purchased, the following questions should be answered to the satisfaction of those making the investment and managing the system.

1. *Can the previous break-even analysis be met on the average?* It would take approximately 44 to 85 bushels of corn or 20 to 27 bushels of soybeans per year to cover the added costs. Any decrease in operating costs or increase in prices received per bushel would lower the added bushels needed to break even. Most irrigators look at their investment as a means of insurance to provide uniform yields and income for their total farm operation. The availability of irrigation equipment permits you to set high yield goals every year, with a firm assurance of reaching these goals.

2. *Can the cash flow for your farm be met? Will irrigation help or hinder?* Remember that the previous discussion was economic and that your loan may be for seven, not ten years, so the rate of interest may be different. Lease programs are offered by most irrigation dealers and may need to be considered if your cash flow is extremely tight. The total finance charge paid over

Table 5. Additional Operating Costs

	Cost	Cost per acre
Fertilizer	$1,600	$11.94
Seed	402	3.00
Herbicide	402	3.00
Hail insurance	268	2.00
Combine fuel	402	3.00
Trucking	268	2.00
Machinery repair	402	3.00
Total	$3,744	$27.94

Table 6. Yield Increase Needed to Cover Fixed, Variable, and Additional Operating Costs

Corn price per bushel	Yield increase in bushels	Soybeans price per bushel	Yield increase in bushels
$1.50	85	$4.75	27
1.70	75	5.00	26
1.90	67	5.25	24
2.10	61	5.50	23
2.30	56	5.75	22
2.50	51	6.00	21
2.70	47	6.25	20
2.90	44	6.50	20

the life of the agreement may be greater, but the payments on the first two or three years of the agreement may be less. You should review the terms of your lease agreement with your legal and tax counsels before making a decision.

3. *How will the investment and operating costs be shared with the landlord if the system is going to operate on rented land?* Irrigation is just one of many investment factors in a farm; it should be considered along with all other inputs by both the landlord and the operator. Traditionally, most of the sandy soils in western Mason County were farmed on a 60:40 basis, with the operator paying all of the seed costs and sharing fertilizer, herbicide, and crop returns 60:40. When irrigation is added, most landlord-tenant operations center on a two-thirds/one-third sharing of the initial investment by the landlord and tenant, respectively, and a sharing of all operating costs and returns on a 50:50 basis. This method of sharing costs is not absolute but can be used as a guide in reviewing the overall farm lease. Dealer lease programs have appeal in situations where the landlord does not want to make the initial purchase but is willing to operate a pay-as-you-go basis.

4. *Will you have the time and management ability to make the system operate?* Irrigation systems do not run themselves completely. They are a new tool with new parts and new engineering concepts. Much study, experimentation, and hard work, therefore, are needed if you are to become a successful irrigator.

Many options are available to the irrigator when purchasing irrigation equipment. The option presented in Tables 1-7 is a diesel unit with the estimated costs. In some areas, power rates make it more economical to use electric motors rather than the diesel units. Operating costs have varied with regard to the base fee, depending on the electric power policy and whether interruptable service is offered or not. Initial investments for the electric units are usually less than diesel units. Table 7 incorporates all of the production costs for irrigated corn, dryland corn, irrigated soybeans, and dryland soybean. Table 8 includes the analysis of the annual fixed and variable costs for a center pivot low pressure irrigation system.

Table 7. Irrigation Total Production Costs, 1989

Total cost	Irrigation corn per acre	Dryland corn (135 bu)	Irrigation soybeans per acre	Dryland soybeans (45 bu)
VARIABLE COSTS				
Seed	$24.00	$21.00	$14.00	$11.00
Pesticides	20.00	17.00	22.00	19.00
Fertilizer	64.94	53.00	30.94	19.00
Machinery, repair, and fuel	48.30	24.00	54.30	20.00
Drying fuels and repair	26.00	16.00	--	--
Interest on operating capital	7.00	7.00	4.00	4.00
Total variable costs per acre	190.24	138.00	125.24	73.00
OTHER COSTS				
Machinery depreciation and interest	113.54	40.00	109.54	36.00
Labor	21.00	21.00	20.00	20.00
Management	17.00	17.00	16.00	16.00
Storing (Interest and bin)	26.00	26.00	18.00	18.00
Miscellaneous	17.00	15.00	17.00	15.00
Total other costs/acre	194.54	119.00	180.54	105.00
Total all costs/acre	384.78	257.00	305.78	178.00
Land Charge	90.00	90.00	90.00	90.00
TOTAL ALL COSTS (including land charges)	$474.78	$347.00	$395.78	$268.00

Illinois Irrigation Association Meeting, January 1990

The Illinois Irrigation Association will be meeting January 16-17, 1990, at the Prairie Capital Convention Center, Springfield, Illinois, as part of the Illinois Specialty Growers Association convention and trade show.

The program includes speakers from the University of Illinois, University of Georgia, Illinois State Water Survey, Nebraska Association of Resource Districts, Cargill Seed Company, and Hartung Seed Company.

For further information, contact the Illinois Irrigation Association, R.R. 1, Box 32A, Kilbourne, IL 62655, (309)543-2307.

D. E. Erickson

D.E. Erickson
Extension Economist

Table 8. 1989 Center Pivot Low Pressure Irrigation System Costs

INITIAL INVESTMENT

	Total cost	Cost per acre
Center pivot	$38,000	$283.58
Well (80 to 100 ft)	7,000	52.24
Pump	8,500	63.43
Engine generator (diesel)	10,000	74.63
Miscellaneous	1,200	8.96
Total (for 134 acres)	$64,700	$482.84

ANNUAL FIXED COSTS

	Cost	Cost per acre
Depreciation (10 years = 10%)	$6,470	$48.28
Interest (11% per year[a])	3,559	26.56
Repairs[b]	1,941	14.49
Total annual average	$11,970	$89.33

ANNUAL VARIABLE COSTS

	Cost	Cost per acre
Diesel fuel (3,500 gal @ $0.95/gal)	$3,325	$24.81
Oil and oil filters	200	1.49
Total annual average	$3,525	$26.30

TOTAL FIXED AND VARIABLE COSTS	$15,495	$115.63

ADDITIONAL OPERATING COSTS

	Cost	Cost per acre
Fertilizer	$1,600	$11.94
Seed	402	3.00
Herbicide	402	3.00
Hail insurance	268	2.00
Combine fuel	402	3.00
Trucking	268	2.00
Machinery repair	402	3.00
Total	$3,744	$27.94

TOTAL ANNUAL IRRIGATION COSTS

	Costs	Cost per acre
Irrigation costs, fixed and variable	$15,495	$115.63
Additional operating costs	3,744	27.94
Total	$19,239	$143.57

[a]Assuming equal payments over the 10 years, the average annual rate would equal 5.5% of the fixed investment.

[b]Assuming 3% of the investment would be paid out for repairs, on the average.

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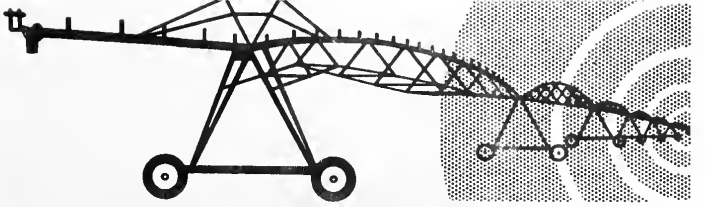

Illinois Irrigation Newsletter

newsletter supported in part by the Water Resources Center of the University of Illinois at Urbana-Champaign

Vol. 11, No. 5 *April 1990*

IN THIS ISSUE:

Water Authorities Formed in Mason-Tazewell Area

Parts of Mason, Tazewell and McLean counties established Water Authorities in elections last fall. The referenda grant the newly Formed local units government powers of water use regulation and taxation necessary to fund their programs. Mason county and four adjoining townships in Tazewell county will be covered by the Imperial Valley Water Authority. This main irrigation area in the state generally has sandy soils and abundant water resources. The referendum to protect long-term water availability, which was based on a 60-40 margin, was supported by the Farm Bureau, the Central Illinois Irrigated Growers, and the local affiliation of the Illinois Irrigation Association.

Interest in protecting the valuable groundwater resource is a longtime passion of Mason County Farm Bureau President Ed Whitaker who says that the economic development and viability of the area depends on protecting and wisely using the groundwater resource. The reference to the "Imperial Valley" is the work of Whitaker and others who visualize a major vegetable production center emerging along the Illinois River sands.

"We are interested in attracting food processing industries to this area based on our vegetable growing potential and our supply of water," Whitaker explains. Whitaker sees these companies creating economic development that will benefit all citizens. He also says that water is a key factor in bringing in factories and by this, agricultural opportunities would be improved.

Southeastern Tazewell County will be served by the Mackinaw Valley Water Authority. The motivating factor for formation of this Authority is more easily defined. The primary function of the Authority is to protect area groundwater from the exploitation of outside groups (primarily creeping municipalities). Melvin Pleines, Public Works Director for the Village of Minier and Water Authority Trustees states, "There may be enough water for outsiders and we are willing to share it, but on our terms." His views stem from alleged interference to existing wells by large production wells in the early 1970's that took place without compensation to those affected. Goals of the current Authority include protecting individual well owners from being damaged without compensation and maintaining local control of resources.

The use of the Water Authority vehicle to protect and manage groundwater is relatively new. The original Water Authority in Illinois was developed in 1959 to generate funding to build Lake Sara for Effingham's water supply. The new use concerns Gary Clark of the Illinois Department of Transportation, Division of Water Resources, a state leader in water issues. He points out the following:

- Funds collected by Water Authorities may be used only for "acquiring necessary property and facilities." They may not be used for operations, studies, data collection, etc.

- State agencies in charge of acting on behalf of all Illinois residents may be reluctant to participate in research or assessment for purely protectionist activities.

Clark was a leader in the Governor's State Water Plan Task Force in 1989 that recommended a series of policy changes to improve state groundwater management. The recommendations were not adopted by the state legislature but may be proposed again in the spring legislative session.

Funds generated by the Authorities may be substantial. The Mackinaw Valley Water Authority will collect about $8,000/year at their present rate while the Imperial Valley Water Authority collection stands to be much larger.

According to existing state statutes Water Authorities have the power to:

1. Inspect wells or other withdrawal points and require withdrawal and use data.

2. Require registration of all wells.

3. Require permits for all additional wells or for expanding or deepening existing wells.

4. Require the sealing of abandoned wells or the repairing of existing wells.

5. Reasonably regulate water use and establish limits upon or priorities as to the use of water.

6. Supplement the existing water supply including acquiring property inside or outside the Authority by purchase or condemnation, and operate various water supply facilities.

7. Sell water inside or outside the Authority.

8. Levy a general tax of up to .08 percent on all taxable property within the authority and issue bonds within specific limits.

9. Restrain violations of the rules of regulation in the circuit court and establish a misdemeanor fine of up to $50/day for such violations.

Other important provisions in the Water Authority Statute germane to application of the Authority are:

1. All entities withdrawing water at the time of the establishment of a Water Authority may continue taking water up to the rated capacity of their equipment.

2. Water used for agricultural purposes, farm irrigation or domestic purposes (up to 4 families/well) are exempt from any provisions of a Water Authority.

These two provisions seemingly exempt current irrigation activities from Water Authority water use regulation. Continued establishment of Water Authorities in Illinois seems likely but some dissatisfaction from the *new use* of the Water Authority powers may compel legislators and state agencies to pursue other forms of groundwater management.

Testing Out Your Center Pivot

Attention paid to your center pivot system last fall will provide some assurance that the major components are ready to go for this season. However, a spring start-up check is an important part of preventative maintenance. Critical breakdowns during high periods of evaporative demand later in the summer can be costly due to yield reductions. Take a moment and run through the following checklist with your center pivot system. (By all means, check your system before you really need it.)

1. Inspect the entire unit for cracks at welds and stress points. Replace or repair any damaged electrical cables and controls and tighten nuts and bolts. Pay particular attention to pivot point and pivot tie-downs.

2. Lubricate all grease fittings at U-joints, bearings, and pivoting joints.

3. For electrically powered systems, disconnect the power and check the

collector ring to be sure all brushes are in good condition and are making solid contact. If the ring shows corrosion, clean with a high-grade electrical contact cleaner. If the cleaner is insufficient, use only fine, high-quality sandpaper or an emery cloth to remove corrosion.

4. Check and tighten all screws, because alternate heating and cooling during the season can cause them to loosen.

5. Check for rodent nests and rodent damage caused by gnawing or biting. If rodents have entered the system, try and find the entryway and close it. If drains were left open last fall, take extra care to check for bird nests.

6. Check all tires for proper inflation and loose lug nuts.

7. Check gearbox lubricant levels and change lubricants if recommended by the manufacturer. If gearboxes were not checked last fall, drain off water that may have accumulated. If water is found, check carefully for cracks in the gearbox caused by winter freezing. Early season start-up offers an excellent opportunity to check for oil drips under each gearbox since the unit has been sitting in one place and will stain if there is a leak.

8. After completing steps 1-6, start the machine and run dry. Listen for abnormal noises in the motor or any of the gearboxes.

9. Remove the end cap and flush to clear the lines and to prevent scale and other materials from clogging nozzles.

10. Check your operator's manual or contact your local dealer for specific annual maintenance guidelines for your machine.

Frequent Causes of Damage

Lightning and animal damage remain the two most frequent causes of problems for center pivot systems. As a chance event, lightning can be especially frustrating and not especially preventable. Lightning could have struck over the off-season so it is wise to check the system early to make appropriate repairs before crunch time. Disconnecting switches in the fall may help control the potential damage of a lightning strike.

How much is a squirrel worth? Some dedicated sportsmen/cooks insist that the squirrel is the best-tasting game known. So, as an entree, there are a variety of opinions concerning a squirrel's value. But to an irrigator near a heavily wooded area, a squirrel can become quite expensive. John Boggs' (of Valley Irrigation) urges irrigators to place salt blocks near the center pivots so the squirrels will concentrate their munching on the less expensive meal. Replacement of 11 wire span cables can be as expensive as $300/span. The moral of the story is that a squirrel's value can be either a positive or negative entry on the accounting ledger.

Center Pivot Icing

Any way you slice it, you don't want to ice it. An infrequent but potentially devastating problem to watch for in early season irrigation is "icing" on trusses. Irrigation of early season corn for the purposes of helping the crop emerge or to "water in" herbicide can be done at fairly low temperatures. But as temperatures approach freezing, a center pivot system can become a "flatland snow-making machine". Due to the high pressure in the system combined with the pressure drop that the water undergoes as it passes through the nozzle, super cooling can form ice even at temperatures slightly above freezing. If ice is allowed to build up on the trusses, weights far in excess of the maximum engineered design can occur. These excessive weights can bend or flatten an irrigation system. As mentioned, this is an infrequent but real concern.

Atrazine Moratorium for Sandy Wisconsin Farmland

A moratorium on the application of atrazine to 2000 acres of sandy farmland in southwestern Wisconsin recently went into effect due to detection of atrazine in excess of state drinking water standards.

Monitors found several well water samples that exceeded 3.5 parts per billion. An article in the April 1990 issue of *Ag Consultant* detailed support for the moratorium by Ciba-Geigy, primary supplier of atrazine. The Wisconsin "best management plan" is similar to that recently adopted in Iowa. The Iowa rule sets a maximum of 1.5 pounds per acre of atrazine in sensitive areas. It further prohibits treating within 50 feet of sinkholes, wells, abandoned wells, or surface water impoundments.

Current discussion within state government is considering how to deal with pesticide management in Illinois. It is quite likely that irrigators will receive increased scrutiny and groundwater monitoring. Also, it is not out of the question that some pesticide labels will be cancelled in highly vulnerable areas like sandy irrigated soils. Future issues of the *Illinois Irrigation Newsletter* will track the progress of such regulations.

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